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Abstract

We consider taxation by a leviathan government and by a utilitarian government in the presence of heterogeneous locations within a country, when migration from one country to another is and is not possible. In a closed economy, a utilitarian government may transfer income from the poor to the rich to reduce rents earned by absentee landlords. When the rich are mobile, a tax on them induces little migration because the tax will reduce the rents on land inhabited by the rich. A race to the bottom need not appear.

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1 Introduction

A state or other jurisdiction which imposes high taxes on the rich may induce some residents to move away. Such migration would appear to limit a state's ability to redistribute income or to finance generous social benefits. The problem may generate a "race to the bottom," with each state attempting to attract rich residents by taxing them at a lower rate than other states do; the equilibrium may have no redistributive taxes. Despite this theoretical possibility, we see governments engaged in large redistribution. Migration may be limited for several reasons: moving is costly; some people prefer one location over another; property values decline in response to higher taxes, thereby reducing the incentives to move.

This paper examines the last two considerations. In particular, we suppose that good locations are scarce in any jurisdiction: people who want to live near the beach or on top of a mountain with a gorgeous view will find such locations limited.¹ We shall see that a small income tax imposed on the rich in a jurisdiction with heterogeneous locations reduces property values in desirable locations, reduces the utility of each rich person, and increases the utility of each poor person. Tax incidence, however, is complicated because a person's utility depends on three elements: his post-tax income, the rent he pays, and the location where he lives. The incomes of rich people, after paying the tax and after paying rents, fall, but by differing amounts. Property values also fall, hurting landlords. These results, which relate to the research tradition in urban economics, thus extend the conventional public finance view on taxes and migration.

We find that incorporating the insights of urban economics, namely that taxes are partly capitalized in property values and rents, can change some conventional results in the public finance literature. A key insight of the literature on tax competition is that mobility of taxpayers reduces the scope for redistribution, and that governments will choose to impose low taxes on persons who may leave the country. This would imply that a utilitarian government which aims to transfer income from the rich to the poor in the absence of migration would engage in less redistribution if the rich can emigrate. We find instead that migration can increase redistribution. We also find that even when taxation does not distort labor supply, a utilitarian government in a closed economy does not fully equalize incomes; it may even engage in regressive redistribution. But if migration is possible, a utilitarian government will not engage in regressive taxation.

2 Literature

Taxes and migration The effect of taxes on migration is a central topic in studies of international tax competition; see, for example, Wildasin (1994) and

¹The scarcity of desirable locations may also make the property tax attractive. We focus, however, on an income tax imposed on rich persons, with labor supply inelastic.

Sinn (1997). Christiansen, Hagen and Sandmo (1994) show how differences in average income tax rates affect migration. Though migration is influenced by relative employment and earnings opportunities, they are considered elsewhere, and we do not.² We focus on income taxes levied on the rich. Wilson (2003) presents an excellent summary and an extension of the results concerning property values and land taxation.

Voting Several papers consider the tax rates that a majority of voters in a jurisdiction will adopt; see Westhoff (1977), Epple, Filimon, and Romer (1984), Epple and Romer (1991), and Goodspeed (1989). The models assume that households differ along a single dimension, typically income. In these models, an appropriately defined marginal rate of substitution is assumed to vary monotonically across household. Use of such a monotonicity condition on the marginal rate of substitution was first introduced by Ellickson (1971). Under this assumption, households will be perfectly stratified by income across jurisdictions.

Epple and Platt (1998) model local jurisdictions in which households differ in both income and tastes, and can thus generate less stark income stratification. Hindricks (1999) considers how redistribution affects mobility, which in turn determines the identity of the voters and the levels of redistribution they favor.

Taxes and property values The effects of taxes on property values and on migration are studied by Epple and Romer (1991). They argue that though local redistribution induces sorting of the population, the induced changes in property values make redistribution feasible. But whereas in Epple and Romer (1991) land is homogeneous, in our model some locations are preferred to others.³ We show that this leads to different implications even when people have identical preferences. Epple and Platt (1998) study redistribution in a system of local jurisdictions when households differ in their preferences and in their incomes. In most models, complete income stratification is a necessary condition for equilibrium. In our model the equilibrium can have rich people live in all communities.

Hansen and Kessler (2001) study the interaction of mobility and taxation, but with a focus different from ours. Their model explains why tax rates are lower in small countries than in large ones. People have different incomes and migration arises from self-selection. In their model, the political equilibrium has rich people voting for low taxes and low grants; poor people vote for high taxes and high grants. Their key asymmetry is geographical size, which differs between the countries. The basic difference between our model and theirs lies in the timing of decisions: they have budgetary policy determined after people

²See Bover, Muellbauer, and Murphy (1989) for labor market aspects, and Haavio and Kauppi (2002) for the effects of liquidity constraints. Cameron and Muellbauer (1998) consider commuting as an alternative to migration.

³Epple and Romer's model is, however more general than ours in their treatment of housing: unlike them we suppose that the size of a house and of a lot is fixed.

move; as in the public finance tradition, we have tax rates set by governments before people move.

We shall analyze tax policy under two alternative assumptions of government preferences. The first type is a Leviathan government which maximizes tax revenue, while transferring a fixed fraction to the poor. The second type is a utilitarian government which maximizes the sum of the utilities of all residents, and does so by transferring income between the rich and the poor.

3 Assumptions

Residents Each resident is either rich or poor. All have the same utility function. The pre-tax income of each rich person is y^R ; the pre-tax income of each poor person is y^P . Land differs in its location and hence in its rent. Location is indicated by e , the elevation at which a person resides. Elevation ranges from 0 to $H = 1$ and is evenly distributed on $[0, 1]$. Each elevation can accommodate a density of one resident. If all the land on the hill is occupied, the population on the hill is unity. We can view quality differences in several ways. For example, the jurisdiction could be viewed as having one hill, or else one major city. In the hill interpretation, higher elevations have a better climate or a better view. In the city interpretation, quality declines with distance from the city.

An individual's utility defined over consumption of goods (x) and elevation (e) is

$$U = u(x) + v(e) = \ln(x) + \ln(e).$$

Initially, the jurisdiction has n^R rich people; migration can change that number. The number of poor residents is fixed at n^P ; they cannot migrate. Assume that both the rich and the poor live on the hill, and that $n^P + 2n^R \leq 1$. Land is thus sufficiently abundant to house all people in the post-migration equilibrium.

Government policy Government can impose only one tax, a lump-sum of τ on each rich person. Below we shall make various assumptions about how the revenue is redistributed. One assumption is that the government redistributes all tax revenue from the rich to the poor. Another assumption is that government is a Leviathan, keeping the tax revenue for its own purposes. We take a more general view, allowing the government to keep a share α of the tax revenue for itself, and redistributing the rest to the poor. Let the number of rich people in jurisdiction i in the equilibrium with migration be n_i^R ; then the total tax revenue is $n_i^R \tau_i$. Thus, the waste by the government is $\alpha n_i^R \tau_i$. Let the transfer to each poor person be t , so that aggregate transfers are

$$n^P t_i = (1 - \alpha) n_i^R \tau_i.$$

We assume throughout that the tax is not confiscatory: the post-tax income of a rich person exceeds the post-transfer income of a poor person. This requires

that

$$\tau_i \leq \frac{n^P(y^R - y^P)}{n^P + n_i^R(1 - \alpha)}.$$

Migration The poor migrate neither into nor out of any jurisdiction. The rich can migrate. This assumption is plausible for much of Europe, where language barriers are more severe for people with less education. The reservation utility to a rich person outside the jurisdiction is given by the standard of living abroad: no rich person will live in a jurisdiction in which his utility is less.

Land Housing (or land) is owned by absentee landlords. Each person within a jurisdiction can choose where to live; the rent at elevation e is c_e .

4 Closed economy

4.1 No poor

We develop the analysis in steps. Suppose first that the economy is closed and with no poor people. The rich then populate locations $[1 - n^R, 1]$. In equilibrium they all enjoy the same utility. The equilibrium rent at the lowest occupied location, $1 - n^R$, is zero. (Were the rent positive, the resident would be better off moving to the neighboring unit with zero rent.) It follows from continuity of the utility function that $\lim_{e \rightarrow (1 - n^R)} c_e = 0$. Thus,

Lemma 1 *Rents decline smoothly towards zero when moving down: $\lim_{e \rightarrow (1 - n^R)} c_e = 0$.*

Above $1 - n^R$, property owners exploit the whole surplus generated by a better location. The rent at any elevation $e > 1 - n^R$ is determined by the condition that a rich person must enjoy the same utility at different locations occupied by the rich: $\ln(y^R - \tau - c_e) + \ln(e) = \ln(y^R - \tau) + \ln(1 - n^R)$, where $y^R - \tau - c_e = x^R$. This gives

$$c_e = \frac{(y^R - \tau)(e - 1 + n^R)}{e}. \quad (1)$$

The above relation determines the equilibrium rent for any given location, with $c_e > 0$ and $c'_e > 0$. Each rich person takes the rent as given when choosing his location and consumption. The willingness to pay for housing increases with elevation, at the expense of foregone consumption. At the top of the hill the rent is $c_1 = (y^R - \tau)n^R$. Tax capitalization is given by the condition

$$\frac{\partial c_e}{\partial \tau} = -\frac{e - 1 + n^R}{e} < 0,$$

and depends on two parameters, location and the size of the rich population. Tax capitalization increases with elevation and with the size of the rich population.

4.2 Poor present

When poor people are present, the population is $n^R + n^P$. Residences, however, are segregated: all rich people live above all poor people. The rent paid by a rich person in the lowest elevation occupied by the rich is determined by the willingness to pay by the poor for locations $1 - n^R - n^P < e < 1 - n^R$. If the poor do not pay any tax or get any transfer, the rent paid by the poor is obtained from $\ln(y^P - c_e) + \ln(e) = \ln(y^P) + \ln(1 - n^R - n^P)$:

$$c_e = \frac{y^P e - y^P(1 - n^R - n^P)}{e}, \quad 1 - n^R - n^P < e \leq 1 - n^R. \quad (2)$$

At the highest location occupied by a poor person, $e = 1 - n^R$, his willingness to pay is thus

$$c_{1-n^R} = \frac{y^P n^P}{(1 - n^R)} > 0. \quad (3)$$

Hence, an increase in the number of poor people hurts each rich person, who must pay strictly higher rents on all locations. The rent at location e above this is determined by the indifference condition

$$\ln(y^R - \tau - c_e) + \ln(e) = \ln(y^R - \tau - \frac{y^P n^P}{(1 - n^R)}) + \ln(1 - n^R).$$

Hence, with poor people present

$$c_e = \frac{(y^R - \tau)(e - 1 + n^R) + y^P n^P}{e}, \quad 1 - n^R < e \leq 1. \quad (4)$$

In the absence of a tax, the rent paid by a rich person is $c_e = \frac{y^R(e - 1 + n^R) + y^P n^P}{e}$.

Assume next that the government transfers a fraction $1 - \alpha$ of the tax revenue to the poor. Then each poor person receives

$$\frac{(1 - \alpha)n^R \tau}{n^P}.$$

Consumption by each poor person is $y^P + \frac{(1 - \alpha)n^R \tau}{n^P} - c_e = x^P$. With such an income transfer, the willingness to pay by the poor for location e is

$$\ln(y^P + \frac{(1 - \alpha)n^R \tau}{n^P} - c_e) + \ln(e) = \ln(y^P + \frac{(1 - \alpha)n^R \tau}{n^P}) + \ln(1 - n^R - n^P).$$

This indifference condition for the rental market allows us to determine the rent at the highest location occupied by the poor:

$$c_{1-n^R} = \frac{y^P n^P + (1 - \alpha)n^R \tau}{(1 - n^R)}.$$

This must also be the rent paid by a rich person at this elevation. Income transfers to the poor will also increase the rents paid by all the rich people above

this location. The rent paid by a rich resident at elevation e (above where the poor live) is⁴

$$c_e = \frac{(y^R - \tau)e - (y^R - \tau)(1 - n^R) + y^P n^P + (1 - \alpha)n^R \tau}{e}.$$

Thus the rent increases with $1 - \alpha$: the greater the fraction of tax revenue transferred to the poor, the higher the rents paid by the rich at all locations. At the highest elevation, the rent is

$$c_1 = (y^R - \tau)n^R + y^P n^P + (1 - \alpha)n^R \tau.$$

4.3 Some rich may consume less than some poor

Without taxes, three types of equilibria can appear:

- 1) Each rich person consumes more than each poor person.
- 2) Some rich people consume less than some poor people.
- 3) Each rich person consumes less than some poor people.

To establish this, note first that the utility of each rich person is the same regardless of whether he lives at the top of the hill or at a lower location. However, the marginal utilities from consumption and location differ. At the top, the marginal utility from consumption is large but from location is small. Moreover, the utility of each rich person from location, $\ln(e)$, is higher than that of any poor person. As a rich person pays a higher rent, his utility from consumption, $\ln(x)$ can be less than that of a poor person. At the elevation $1 - n^R$, the utility of the rich and of the poor from location are equal and they pay an equal rent; the rich person enjoys a higher utility from consumption than does his neighboring poor person. At higher elevations, however, rents are higher and the utility from consumption of a rich person can be smaller than the utility of a poor person. A condition for this can be derived by comparing the utilities from consumption of the highest rich person and lowest poor person. When $\tau = 0$, the rent paid by the rich at the top is $y^R n^R + y^P n^P$. Then the condition in terms of consumption is

$$\begin{aligned} y^R - (y^R n^R + y^P n^P) &< y^P. \\ y^R(1 - n^R) &< y^P(1 + n^P). \\ y^R &< y^P \frac{1 + n^P}{1 - n^R}. \end{aligned}$$

As $\partial(\frac{1+n^P}{1-n^R})/\partial n^R > 0$ and $\partial(\frac{1+n^P}{1-n^R})/\partial n^P > 0$, we find that when n^P and n^R are large and with a given y^P and y^R , this inequality holds: a rich resident at the top consumes less than a poor person at the bottom. To see why, consider an increase in the poor population. The poor must live at the bottom, in locations previously unoccupied. This, however, means that the rents at higher elevations

⁴This can be solved from the indifference condition that the utility of all the rich must be equal, namely $\ln(y^R - \tau - c_e) + \ln(e) = \ln(y^R - \tau - \frac{y^P n^P + (1-\alpha)n^R \tau}{(1-n^R)}) + \ln(1 - n^R)$.

occupied by the poor must increase. The rich person living next to the poor person must also pay a higher rent. But then, for equal utilities, rents paid by the rich at higher elevations must also rise.

Consider next an increase in the rich population. Some rich people will now live at the higher elevations that had been occupied by the poor, inducing the poor to occupy yet lower elevations. The lowest poor person consumes as much as before, but suffers from living at a lower elevation. The poor person at the highest elevation occupied by the poor must suffer the same utility loss: he loses utility from residing at a lower elevation than he had before the number of rich people increased. This can be seen as follows. With $\tau = 0$ the rent paid by a rich person at elevation e is

$$c_e = \frac{y^R(e - 1 + n^R) + y^P n^P}{e}.$$

At the lowest residence of a rich person, $e = 1 - n^R$, and $c_e = y^P n^P / (1 - n^R)$. Taking the derivative, $\partial(y^P n^P / (1 - n^R)) / \partial n^R > 0$. Thus the rent paid by the lowest rich person rises. Therefore, all the rich throughout the hill must pay a higher rent. The greater the increase in the distance between the lowest rich person and the highest rich person, the greater the drop in consumption of goods by the rich at the top.

Even though a rich person may consume less goods than some poor persons, the utility of a rich person must always exceed that of a poor person. For otherwise

$$\begin{aligned} \ln(y^R - \frac{y^P n^P}{1 - n^R}) + \ln(1 - n^R) &< \ln(y^P) + \ln(1 - n^R - n^P) \\ y^R(1 - n^R) - y^P n^P &< y^P(1 - n^R - n^P) \\ y^R &< y^P. \end{aligned}$$

This can never hold. Nevertheless, consumption of goods by the lowest rich person may be less than that of the lowest poor person. That is, in equilibrium it can hold that $\ln(y^R - \frac{y^P n^P}{1 - n^R}) < \ln(y^P)$, or that $y^P > y^R(1 - n^R) / (1 + n^P - n^R)$, for $n^P + n^R >> 0$). If $n^P > 0$ this can hold even if $y^R > y^P$. Intuitively, if any income group is large, equilibrium rents may be high, reducing consumption by the rich.

Lemma 2 *If the number of poor people is large, rents are high, reducing consumption by the rich.*

4.4 Optimal tax in a closed economy

4.4.1 Leviathan government

Suppose the government maximizes tax revenue, subject to the constraint that it must return an exogenous fraction $1 - \alpha$ of the tax revenue to the poor. In a closed economy, this amounts to maximizing the tax rate subject to the

condition that the post-tax income of an initially rich person exceeds the post-transfer income of an initially poor person.

4.4.2 Utilitarian government

Consider next a utilitarian government which transfers all tax revenue to the poor ($\alpha = 0$), maximizing aggregate utility. If rents and residences would stay constant, this would amount to finding the tax rate on the rich which makes the marginal utilities across people equal. With endogenous rents, this cannot be achieved with a uniform tax on the rich and a uniform transfer to the poor. The reason is that the marginal utility from consumption depends on rents paid, which differ by location. Equalizing aggregate utility within each group requires differences in utility from consumption to compensate for differences in the utility from location. Social welfare is⁵

$$SWF = \int_{1-n^R}^1 [u^R(y^R - \tau - c_e(\tau)) + v(e)] de + \int_{1-n^R-n^P}^{1-n^R} [u(y^P + \frac{n^R \tau}{n^P} - c_e(\tau)) + v(e)] de.$$

We note that a person's marginal utility from consumption and the effect of a tax on his rent and on his consumption depend on where he lives. A rich person living at the top of the hill pays a high rent, may consume little, and so may have a higher marginal utility of consumption than does a poor person. This can make a negative tax with a transfer from the poor to the rich be optimal.

Consider a per capita tax τ imposed on each rich person. The optimal tax for a utilitarian government satisfies

$$\frac{\partial SWF}{\partial \tau} = \int_{1-n^R}^1 \left(\frac{\partial u^R}{\partial x^R} \right) \left(\frac{\partial x^R}{\partial \tau} \right) de + \int_{1-n^R-n^P}^{1-n^R} \left(\frac{\partial u^P}{\partial x^P} \right) \left(\frac{\partial x^P}{\partial \tau} \right) de = 0.$$

Social optimality then requires that the tax equalize the sum of the weighted marginal utilities of consumption across income groups, $\frac{\partial u^R}{\partial x^R} = \frac{1}{x^R}$, $\frac{\partial u^P}{\partial x^P} = \frac{1}{x^P}$, but weighted by the relative population size and by the marginal tax effects on consumption, $\frac{\partial x^R}{\partial \tau} = -\frac{1}{e} < 0$, $\frac{\partial x^P}{\partial \tau} = \frac{(1-\alpha)n^R}{n^P} + \frac{1-e-\alpha n^R}{e} > 0$. Introducing $\alpha = 0$, we obtain $\frac{\partial x^P}{\partial \tau} = \frac{n^R}{n^P} + \frac{1-e}{e}$. Inserting, the social optimum satisfies

$$\frac{\partial SWF}{\partial \tau} = \int_{1-n^R}^1 \left(\frac{\partial u^R}{\partial x^R} \right) \left(-\frac{1}{e} \right) de + \int_{1-n^R-n^P}^{1-n^R} \left(\frac{\partial u^P}{\partial x^P} \right) \left(\frac{n^R}{n^P} + \frac{1-e}{e} \right) de = 0.$$

The optimal tax equalizes the weighted sum of the marginal utilities of consumption across income groups, adjusted for the differential direct and indirect tax effects on rents and hence on consumption.

To evaluate this social optimality condition requires considering the effect of taxes and transfers on rents. Finding the optimal tax rate, however, is simplified by recognizing the key property of the model that the rents adjust so that, in equilibrium, all residents in the same income class have the same utility

⁵We assume absentee landlords whose income thus does not enter into social welfare.

regardless of their location. It is also useful to note that the utility of each poor person is identical to that of the poor person paying zero rent. Thus, to determine the optimal tax rate it suffices to derive the effect of the tax on the resident at the lowest location in each income group. Social welfare is then the product of the size of each income group and the utility of any member in that group, say of the person at the lowest location. Social welfare is thus

$$SWF = n^R U^R + n^P U^P.$$

The utility of the poor person living at the lowest elevation is

$$\begin{aligned} U^P &= \ln(y^P + \frac{n^R \tau}{n^P}) + \ln(1 - n^R - n^P) \\ &= \ln((y^P + \frac{n^R \tau}{n^P})(1 - n^R - n^P)). \end{aligned}$$

The utility of the rich person living at a lower elevation than any other rich person is

$$\begin{aligned} U^R &= \ln(y^R - \tau - \frac{y^P n^P + n^R \tau}{(1 - n^R)}) + \ln(1 - n^R) \\ &= \ln((y^R - \tau)(1 - n^R) - y^P n^P - n^R \tau). \end{aligned}$$

Thus,

$$\begin{aligned} SWF &= n^R \ln((y^R - \tau)(1 - n^R) - y^P n^P - n^R \tau) + n^P \ln((y^P + \frac{n^R \tau}{n^P})(1 - n^R - n^P)) \\ &= n^R \ln(y^R(1 - n^R) - \tau - y^P n^P) + n^P \ln((y^P + \frac{n^R \tau}{n^P})(1 - n^R - n^P)). \end{aligned}$$

The first-order condition for maximizing this social welfare function is⁶

$$n^R \frac{-1}{y^R(1 - n^R) - \tau - y^P n^P} + n^P \frac{\frac{n^R}{n^P}}{y^P + \frac{n^R \tau}{n^P}} = 0.$$

The optimal tax by a utilitarian government is therefore

$$\tau = \frac{1}{n^R/n^P + 1} (-y^P(1 + n^P) + y^R(-n^R + 1)). \quad (5)$$

The optimal tax depends on the incomes y^P and y^R and on the population sizes n^P and n^R .

Proposition 3 *A utilitarian government may impose either a positive or a negative tax on the rich.*

⁶The second-order condition reveals that this gives the tax rate maximizing social welfare.

Proof. From (5), $\tau \geq 0 \iff y^R/y^P \geq \frac{1+n^P}{1+n^R}$. ■

A negative tax means that the government transfers from the poor to the rich. The condition that the after-tax income of the rich is not smaller than the after-transfer income of the poor translates into the condition

$$\tau \leq \frac{n^P(y^R - y^P)}{n^R + n^P} \quad (6)$$

The condition that τ in (5) fulfills (6) is satisfied. We find an even stronger result that

Proposition 4 *A utilitarian government does not fully equalize incomes.*

Proof. We show that the tax rate chosen by a utilitarian government is less than $\frac{n^P(y^R - y^P)}{n^R + n^P}$ in (6). This holds when

$$\frac{1}{n^R/n^P + 1} (-y^P(1 + n^P) + y^R(-n^R + 1)) < \frac{n^P(y^R - y^P)}{n^R + n^P}.$$

This reduces to the condition $n^P y^P + n^R y^R > 0$, which always holds. ■

To improve understanding of utilitarian taxation, let $y^R = 1$ and $n^P = 0.2$. The first normalization is without loss of generality. The second assumption ensures a sufficient number of poor persons. Then the condition for a positive τ is that

$$y^P < \frac{5}{6}(1 - n^R). \quad (7)$$

If this condition is not satisfied, then a utilitarian government transfers from the poor to the rich.

Thus, a utilitarian government does not fully equalize the incomes of the rich and the poor, and may even transfer income from the poor to the rich. Moreover, the optimal utilitarian tax policy does not equalize the marginal utilities of consumption across citizens. Rather, it is optimal to equalize the marginal utility of disposable income weighted by the shares of population and the marginal tax effects on consumption.

The intuition for the result relates to the insight made by Mirrlees (1972). He shows that when otherwise identical people live in different locations and so spend different amounts on transportation, different people will have different marginal utilities of income. Maximizing social welfare calls not for equalizing incomes, but for equalizing the marginal utilities of income. In other words, even with identical people, inequality of income distribution is part of the social optimum. In our model, the rich may consume less than the poor, and so enjoy a higher marginal utility of consuming goods; maximizing social welfare would then call for transfers to the rich. A related explanation for our finding lies in the property market. By transferring income from the poor, the government reduces the rents that these are willing to pay. This, in turn, directly reduces the rent paid by each rich person. Thus, by transferring income from the poor to the rich, the government reduces rents and thus increases consumption.

We can also consider a utilitarian government which chooses different weights for different income-earners. A government with Rawlsian preferences would maximize the welfare of the poor,

$$SWF = n^P \ln((y^P + \frac{n^R \tau}{n^P})(1 - n^R - n^P)).$$

Then, not surprisingly, $\frac{\partial SWF}{\partial \tau} > 0$: unlike an equal-weighting utilitarian government, a Rawlsian government would equalize the after-tax income of all residents. This naturally satisfies the constraint that the post-tax income of the rich does not fall below that of the poor.

5 Open economy

5.1 Leviathan governments with migration

We now turn our attention to migration between countries. Assume two countries, a and b , with n^R rich people initially living in each country. The rich can migrate at zero cost, exhibit no home country preference. Each jurisdiction has $n^P \geq 0$ poor residents, who do not migrate. Each resident pays taxes in the country in which he lives. Then a domestic tax on the rich creates an incentive to emigrate abroad. We thus make the lowest locations occupied in each country endogenous. To ensure sufficient space in each jurisdiction for immobile domestic poor and mobile rich from both jurisdictions, we assume that $n^P + 2n^R \leq 1$. As we are concerned with tax competition, in our time line governments simultaneously choose their tax rates; people observe the tax rates when deciding to migrate.

The government redistributes a fraction $1 - \alpha$ of tax revenue to the poor. This generates a feed-back between taxation and migration of the rich. The larger the transfer to the poor, the higher the poor bid rents. This in turn makes the jurisdiction less desirable to the rich. Thus, we expect more people to migrate in response to any given tax difference the greater the fraction of tax revenue the government transfers to the poor. But counteracting this, migration of the rich reduces transfers to the poor, thus reducing their willingness to pay for good locations. This in turn limits migration in response to a given tax difference.

The migration equilibrium for any given tax is determined by a simultaneous system of six equations. These represent per capita transfers to the poor and the rents paid by the rich at the lowest elevation that they occupy in the two countries, population identity, and the arbitrage condition that the utility of the rich is the same in the two jurisdictions.

The per-capita transfer to the poor in country i , $i \in \{a, b\}$, is

$$t_i = \frac{(1 - \alpha)n_i^R \tau_i}{n^P}. \quad (8)$$

The arbitrage condition in the rental market gives the rent paid by the poor in country i in the highest location that they occupy

$$\begin{aligned} & \ln(y^P + \frac{(1-\alpha)n_i^R\tau_i}{n^P} - c_{1-n_i^R}) + \ln(1 - n_i^R) \\ = & \ln(y^P + \frac{(1-\alpha)n_i^R\tau_i}{n^P}) + \ln(1 - n_i^R - n^P). \end{aligned} \quad (9)$$

This condition states that the utility of the poor living at the highest location occupied by the poor equals the utility of the poor living at the lowest occupied location (where the rent is zero). Equation (9) yields

$$c_{1-n_i^R} = \frac{y^P n^P + (1-\alpha)n_i^R\tau_i}{(1 - n_i^R)}. \quad (10)$$

Population identity states that the sum of post-migration rich populations equals the sum of initial rich populations:

$$n_a^R + n_b^R = 2n^R. \quad (11)$$

The arbitrage condition imposed by migration by the rich across the two jurisdictions states

$$\ln(y^R - \tau_a - c_{1-n_a^R}) + \ln(1 - n_a^R) = \ln(y^R - \tau_b - c_{1-n_b^R}) + \ln(1 - n_b^R). \quad (12)$$

The arbitrage conditions in the rental market state that the utility of a rich person is the same at all locations occupied by the rich, so it suffices to present migration equilibrium as equating utilities of arbitrarily chosen rich individuals in the two countries. We choose those rich people living at the lowest elevation occupied by rich people in each country. As utility functions are continuous, rents are also continuous with elevation. Thus, the rent paid by the rich at the border between the rich and the poor equals the rent that would be paid by a poor person at the same location. Substituting $c_{1-n_a^R}$ and $c_{1-n_b^R}$ from (10) and inserting (11), we can solve from the migration arbitrage condition the post-migration rich population in country a :

$$n_a^R = \frac{(y^R - \tau_a) - (y^R - \tau_b)(1 - 2n^R) + (1-\alpha)2n^R\tau_b}{2y^R - \alpha\tau_a - \alpha\tau_b}. \quad (13)$$

Similarly, in the post-migration equilibrium the number of rich persons living in country b is

$$n_b^R = \frac{(y^R - \tau_b) - (y^R - \tau_a)(1 - 2n^R) + (1-\alpha)2n^R\tau_a}{2y^R - \alpha\tau_a - \alpha\tau_b}. \quad (14)$$

Note that (13) and (14) are independent of the number of poor persons. Though migration depends on the share of tax revenue transferred to the poor,

it does not depend on how many poor receive the transfer.⁷ If there are no poor people, then α must equal 1. Equations (13) and (14) then simplify to

$$n_a^R(n^P = 0) = \frac{(y^R - \tau_a) - (y^R - \tau_b)(1 - 2n^R)}{2y^R - \tau_a - \tau_b} \quad (15)$$

and

$$n_b^R(n^P = 0) = \frac{(y^R - \tau_b) - (y^R - \tau_a)(1 - 2n^R)}{2y^R - \tau_a - \tau_b}. \quad (16)$$

5.1.1 Nash equilibria with tax competition

A government which aims to maximize its tax revenue in a closed economy raises the tax rate to equalize the after-tax income of the rich and the poor. In an open economy, the ability of the rich to emigrate imposes an additional constraint. Therefore, even a revenue maximizing government may choose a tax rate that does not equalize incomes: potential migration by the rich disciplines government, as suggested by Brennan and Buchanan (1980). With endogenous property values, this intuition needs to be re-examined. This is our agenda here.

Assume that each government maximizes its tax revenue, subject to the constraint that the post-tax income of a rich person exceeds the post-transfer income of a poor person, and that a fraction $1 - \alpha$ of tax revenue is transferred to the poor. If there are no poor, then $\alpha = 1$; $\alpha = 1$ may hold also in the presence of the poor. By (13), tax revenue in jurisdiction a is

$$t^a = \tau_a \frac{(y^R - \tau_a) - (y^R - \tau_b)(1 - 2n^R) + (1 - \alpha)2n^R\tau_b}{2y^R - \alpha\tau_a - \alpha\tau_b}.$$

Maximizing with respect to the tax rate, τ_a , yields the first-order condition

$$(-2\tau_a + \tau_b + 2n^R y^R - \alpha 2n^R \tau_b)(2y^R - \alpha\tau_a - \alpha\tau_b) + \alpha\tau_a(-\tau_a + \tau_b + 2n^R y^R - \alpha 2n^R \tau_b) = 0.$$

By the negativity of the second-order condition, the first-order condition yields tax rates maximizing tax revenue. In a symmetric equilibrium, $\tau_a = \tau_b = \tau^N$. The first-order condition therefore simplifies to

$$(-\tau^N + 2n^R y^R - \alpha 2n^R \tau^N)(2y^R - 2\alpha\tau^N) + \alpha\tau^N(2n^R y^R - \alpha 2n^R \tau^N) = 0.$$

This leads to a second-order algebraic equation in the tax rate. The only solution satisfying the restrictions $y^R > 0$, $n^R > 0$ and $0 \leq \alpha \leq 1$ is

$$\tau^N = \frac{2n^R y^R}{n^R \alpha + 1}. \quad (17)$$

We see that an increase in the share of tax revenue government retains reduces the tax in both countries. For intuition, recall that each government aims to maximize the product of $\alpha\tau_i$ and n_i^R , $i \in \{a, b\}$. For any given tax rate assumed

⁷Note, however, the requirement that the rich cannot be made poorer than the poor.

to be chosen by the other government, a decrease in the country's tax rate increases the tax base by encouraging immigration, but reduces the tax revenue collected from the initial tax base. Each government balances these effects. An increase in α increases the value of each tax payer with any given tax rate, thus intensifying incentives to compete for taxpayers. Each government then gains from reducing the tax on the rich. A country which imposed a high tax would lose tax base to the other country which imposes a lower tax. The Nash equilibrium in tax rates thus requires lower tax rates in both countries. To summarize,

Proposition 5 *Assuming that the Leviathan government is not constrained by (6), the optimal tax on the rich increases with the share of tax revenue transferred to the poor.*

Proof. The result follows from $\partial\tau^N/\partial\alpha < 0$. ■

It remains to verify that the tax rate is not so high that it would make the after-tax income of the rich be less than that of the poor. This requires that

$$\alpha \geq \frac{2n^R y^R (n^P + n^R) - n^P (y^R - y^P)}{n^R n^P (y^R - y^P) + n^R 2n^R y^R}.$$

Were α low, the government would transfer much of its tax revenue to the poor in each country. The required condition may then be violated. On the other hand, high α helps satisfy this condition for the further reason that it encourages the governments to only lightly tax the rich.

If the governments transfer all revenue, $\alpha = 0$, the tax rate is $\tau = \min(2n^R y^R, \frac{n^P (y^R - y^P)}{n^P + n^R})$ where $2n^R y^R$ is from (17) and $\frac{n^P (y^R - y^P)}{n^P + n^R}$ is the tax rate when incomes of the rich and the poor are fully equalized after taxes and transfers.⁸

The findings suggest that when each government aims to maximize its revenues, international tax competition does not lead to a race to the bottom. This can be verified from (17) with strictly positive tax rate $\tau^N = \frac{2n^R y^R}{n^R \alpha + 1} > 0$ for all $0 \leq \alpha \leq 1$. This result arises from the rental markets when good locations are scarce, so that the tax is capitalized in rents. The fall in rents ensures that differences in taxes do not lead to corner solutions with all the rich moving to the country with a lower tax. In the absence of a rental market and of land scarcity, tax competition would lead to zero tax rates. But in our model the equilibrium tax is positive.

We summarize with

Proposition 6 *Even when the rich are mobile, taxes do not show a race to the bottom. Capitalization of taxes in rents which makes landlords bear some of the tax burden, and migration which raises rents in the destination country, reduce the incentives to migrate. With identical jurisdictions, the equilibrium has no migration. The equilibrium tax on the rich is either equal to or lower than it would be in a closed economy.*

⁸For (6) not to bind, we must have $2n^R y^R \leq \frac{n^P (y^R - y^P)}{n^P + n^R}$.

For numerical illustration, let $y^R = 1$ and $n^P = 0.2$. This limits the number of the rich to $0 < n^R \leq 0.4$, thus allowing us to analyze the cases where the relative number of the rich varies from arbitrarily low values to twice the number of the poor. The tax is then

$$\tau = \begin{cases} 2n^R, & \text{if } y^P \leq 1 - 2n^R - 10(n^R)^2 \\ \frac{1-y^P}{1+5n^R}, & \text{if } y^P > 1 - 2n^R - 10(n^R)^2 \end{cases} \quad (18)$$

If instead each government retains all the tax revenue, the tax rate is $\tau = \min(\frac{2n^R y^R}{n^R+1}, y^R - y^P)$. For our numerical values,

$$\tau = \begin{cases} \frac{2n^R}{1+n^R}, & \text{if } y^P \leq \frac{1-n^R}{1+n^R} \\ 1 - y^P, & \text{if } y^P > \frac{1-n^R}{1+n^R} \end{cases}. \quad (19)$$

Therefore, if the income of the poor is sufficiently low, a Leviathan government chooses a higher tax when it redistributes to the poor; if the income of the poor is sufficiently high, it chooses a higher tax when it retains all the tax revenue. We summarize these results as

Proposition 7 *If the income of the poor is sufficiently low, then tax competition between Leviathan governments leads to a higher tax rate if the governments distribute their tax revenue to the poor. If the income of the poor is sufficiently high, then tax competition between Leviathan governments leads to a higher tax rate if the governments do not distribute their tax revenue to the poor.*

We notice that the tax equilibrium may differ if the government in either jurisdiction has other objectives. For example, the government in one jurisdiction may maximize tax revenue, while the other has a Rawlsian welfare function.

5.2 Utilitarian governments with migration

Assume instead that each government maximizes the utility of citizens initially living in the country.⁹ Our qualitative results do not depend on the particular functional form of the utility function assumed below, but hold for any linear transformation of it.

In choosing the tax, a government must take into account the public budget constraint, the effects of a tax on rents, and migration responses that equalize the utility of the rich between the two jurisdictions. This suggests that migration increases the cost of increasing the utility of the rich. On the other hand, a heavy tax on the rich not only reduces their utility, but also causes them to emigrate, thus reducing tax revenue from them. As the emigration of the rich also affects rents paid by the poor and locations where they live, the effects of the mobility of the rich on optimal utilitarian tax policy are a priori ambiguous.

⁹This assumption is needed because if the government would maximize the sum of the utilities of citizens living in the country after migration, and if the utility functions would have negative values, then each government would want a zero population.

To find an optimal tax by the government, we must first solve the migration responses by the rich and the equilibrium in the rental market. These are derived in the previous section. The social welfare function for country a is

$$SWF = n^P \ln(y^P + t_a) + n^P \ln(1 - n^P - n_a^R) + n^R \ln(y^R - \tau_a - c_{1-n_a^R}) + n^R \ln(1 - n_a^R).$$

Inserting (8), (10) and (13) results in

$$\begin{aligned} SWF = & n^P \ln(2y^R n^P y^P - \tau_a^2 + \tau_a \tau_b + 2\tau_a n^R y^R) + n^P \ln(2y^R + \tau_a - \tau_b - 2n^R y^R - 2y^R n^P) \\ & + n^R \ln(y^R(2y^R - \tau_a - \tau_b - 2n^R y^R) - 2y^R y^P n^P) \\ & - n^P \ln(2y^R n^P) - n^P \ln(2y^R) - n^R \ln(2y^R). \end{aligned}$$

Differentiating with respect to τ_a yields

$$\begin{aligned} \frac{\partial SWF}{\partial \tau_a} = & \frac{n^P(-2\tau_a + \tau_b + 2n^R y^R)}{2y^R n^P y^P - \tau_a^2 + \tau_a \tau_b + 2\tau_a n^R y^R} + \frac{n^P}{2y^R + \tau_a - \tau_b - 2n^R y^R - 2y^R n^P} \\ & + \frac{-n^R}{2y^R - \tau_a - \tau_b - 2n^R y^R - 2y^P n^P}. \end{aligned}$$

The analysis of Nash equilibria must distinguish between solutions in which the condition that the tax cannot make the after-tax income of the rich less than the after-transfer income of the poor does or does not bind. This condition is given by $\tau \leq \frac{n^P(y^R - y^P)}{n^R + n^P}$. When this condition does not bind, we can simplify by using the symmetry property that $\tau_a = \tau_b = \tau$:

$$\begin{aligned} & \frac{n^P(-\tau + 2n^R y^R)}{2y^R n^P y^P + 2\tau n^R y^R} + \frac{n^P}{2y^R - 2n^R y^R - 2y^R n^P} \\ & + \frac{-n^R y^R}{(y^R(2y^R - 2\tau - 2n^R y^R) - 2y^R y^P n^P)} = 0. \end{aligned} \quad (20)$$

Numerical analysis gives our main result:

Proposition 8 *Utilitarian governments may choose either lower or higher taxes on the rich when migration is possible than when it is not.*

Proof. We prove existence with numerical examples exhibiting the claimed qualitative results. If $n^P = n^R = y^P = 0.1$ and $y^R = 1$, the optimal tax in a closed economy (with migration not possible) is 0.395; the optimal tax under tax competition (with migration possible) is 0.195. If $n^P = n^R = 0.1$, $y^P = 0.5$ and $y^R = 1$, the optimal tax in a closed economy is 0.175, and the optimal tax under tax competition is 0.183. ■

It is no surprise that migration (or tax competition) can lead to lower taxes: the ability of the rich to migrate imposes an additional constraint on the government's ability to tax them. But the opposite result appears novel and surprising. The reason tax competition can increase tax rates is because of the effects that appear in the rental market for land. Emigration by rich taxpayers reduces competition for desirable locations and so reduces rents. The reduced rents benefit

the poor, either because they pay lower rents, or because they live in better locations. The immigration of the rich, on the other hand, generates two effects for the receiving country. Rich migrants generate more tax revenue. But they also bid up rents. When the rent effect dominates, a utilitarian government would prefer to induce part of the domestic rich to migrate to the other country. As symmetric countries in a Cournot-Nash equilibrium choose identical tax rates, there is no migration in equilibrium. A government, however, may impose a higher tax than in a closed economy. Thus, the ability of the rich to avoid taxes by migrating hurts them by inducing both countries to impose higher taxes.

6 Conclusion

The urban economics view of taxation and migration complements the standard public finance view of taxation with mobility. The fall in property values reduces the incentive of the rich to migrate, thereby allowing for more redistributive taxation than is predicted by standard models in public finance. Our paper established two conditions that together create scope for income redistribution from the rich to the poor even in the absence of mobility costs or complementarities between the rich and the poor: (i) the scarcity of desirable locations and (ii) lower willingness to pay by the poor for favorable locations. If either condition fails the scope for redistribution is limited.

We found that when rents are endogenous, a utilitarian government in a closed economy may redistribute from the poor to the rich. The intuition for this was that by taxing the poor, the government reduces rents that both the poor and the rich pay. The resultant utility gains may exceed the decline in consumption by the poor. Related to this, we also find that some or, in some cases, even all the rich may consume less non-housing goods than do the poor. The marginal utility of consumption for a rich person may exceed the marginal utility of consumption for a poor person, further justifying transfers to the rich.

When the rich can migrate, and government disregards the welfare of landlords, a utilitarian government may impose a higher tax than when the rich cannot migrate. The result can arise because a tax which induces emigration by the rich reduces demand for desirable locations, allowing the poor to pay lower rents or to enjoy better locations. The increased number of rich people in the other country can also generate an externality, reducing the welfare of the poor in that country. Tax competition can then lead both countries to tax the rich more heavily than they otherwise would. Though such a strong result does not always apply, it suggests that accounting for responses in the housing market can overturn common views on the effects of migration on income redistribution.

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